AMICI CURIAE

FERNANDO L. ALVARADO is professor of Electrical and Computer Engineering at the University of Wisconsin at Madison. A professional engineer and computer scientist, Professor Alvarado is an established leader in technical policy elements of the electric power industry. His areas of expertise include policies for market design and power system operation and power system security and stability issues in interactions between power systems. He is the author or coauthor of more than 80 technical journal publications, books and book chapters, and almost 200 conference presentations and reports. Professor Alvarado is a member of the IEEE, the Society for Computer Simulation (SCS) and the Society for Industrial and Applied Mathematics (SIAM), as well as vice chairman of the IEEE Energy Policy Committee. He earned his Bachelor of Science in Electrical Engineering at the National University of Engineering in Lima, Peru, his Master of Science in Electrical Engineering from Clarkson College of Technology, and his Ph.D in Computer, Information and Control at the University of Michigan at Ann Arbor.

CLINT ANDREWS, P.E., Ph.D., is an assistant professor in the Bloustein School of Planning and Public Policy at Rutgers University. He was educated at Brown and MIT as an engineer and planner. Previous experience includes working in the private sector on energy issues, helping to launch an energy policy project at MIT, and helping to found a science policy program at Princeton. He is Vice President of the Society on Social Implications of Technology of the Institute for Electrical and Electronics Engineers (IEEE); he is a member of the IEEE-USA Energy Policy Committee and the IEEE Power Engineering Society System Economics Committee, a past consultant to numerous electric utilities and their regulators, and an active energy policy researcher. He has authored three books. In 2000, he received a *3rd Millenium Medal* from the IEEE for contributions at the interface of technology and society.

SHIMON AWERBUCH has 30 years of experience in finance, regulatory economics, energy economics and economic development, involving the private sector and all levels of government. Dr. Awerbach has served as Chief of Economic and Policy Studies for the Utility Intervention Office of the NY State Executive Department. He has also served with the Management Consulting Service of Ernst & Young and held policy positions with the NY State Governor's Economic Development Board and the NY State Legislature. He has contributed over 50 articles to such journals as the *American Economic Review*, *Journal of Regulatory Economics* and is a member of the Editorial Board of *Energy Policy*. He is the co-author of *Independent Transmission Companies: Unlocking the Benefits of Electricity Restructuring* (PUR, November 1999) and the co-editor of *The Virtual Utility: Accounting, Technology and Competitive Aspects of the Emerging Industry* (Kluwer, 1997). He has also presented his research findings to delegates of the *United Nations Commission on Sustainable Development* in New York and has testified extensively in regulatory proceedings. Dr. Awerbach received his Ph.D. in Urban-Environmental Studies from Rensselaer Polytechnic Institute.

JUDITH B. CARDELL is an electrical engineer and policy analyst with 10 years of experience in modeling and analyzing electric power systems and electricity markets. Currently a Senior Associate with Tabors Caramanis & Associates, Dr. Cardell also spent several years as an economist and engineer for FERC. Dr. Cardell previously worked at the MIT Laboratory for Electromagnetic and Electronic Systems, and was a graduate instructor at MIT for power systems and energy policy courses. A member of the IEEE's Energy Policy Committee, Dr. Cardell has published articles on energy policy and electric market modeling. Dr. Cardell earned her Ph.D. in Technology Management and Policy from MIT's Department of Electrical Engineering and Computer Science.

BRIAN CORY is Professor Emeritus in Electrical and Electronic Engineering at Britain's Imperial College in London, where he taught for almost 40 years until 1993. Dr. Cory's research interests have been focused on virtually all aspects of electrical energy supply, including both operating systems issues as well as policy issues in the deregulation and privatization of Britain's electricity industry. In the last five years alone, he has published close to a dozen professional journal articles on topics ranging from the pricing of electricity transmission and distribution to optimizing pumped storage generation, as well as a critical review of Great Britain's reorganized electricity supply industry and a proposal for neural-network based methods for evaluating power system voltage stability.

PETER CRAMTON is Professor of Economics at the University of Maryland and President of Market Design Inc. For several electric utilities, Professor Cramton has led the auction designs for generation asset divestiture, standard offer service, and NUG entitlements under power purchase agreements. He has advised ISO New England on the design of New England's wholesale electricity market. He has also advised numerous e-commerce market makers on market design for business-to-business trading. He has served as an auction advisor in spectrum auctions for many companies worldwide, as well as the FCC, the U.S. Department of Justice, and several foreign governments. Before joining the University of Maryland faculty in 1993, he was an Associate Professor at Yale University and a National Fellow at the Hoover Institution at Stanford University. He has published numerous articles on auction theory and auction practice in major journals. Professor Cramton received his B.S. in Engineering from Cornell University and his doctorate in Business from Stanford University.

DAVID HAYWARD is an electrical engineer with a long career in the electric utility industry, specializing in power systems operation. Mr. Hayward worked at New England Electric System for close to 40 years, where he held a number of key positions in bulk power system operations. He worked as a Power System Dispatcher, then spent several years doing long range system planning and performing transmission network analysis studies. He served on the committees that analyzed the 1965 Northeast Blackout. Mr. Hayward is a Senior Member of IEEE and has served on a number of regional and national IEEE committees. He is a former Chairman of the Current Operating Problems Subcommittee (COPS) and a former member of CIGRE. Mr. Hayward has a BS in Electrical Engineering from Tufts University and is a graduate of the Greater Boston Executive Program at the MIT Sloan School.

ERIC HIRST is an independent consultant focusing on issues related to restructuring the U.S. electricity industry. He holds a doctorate in Mechanical Engineering from Stanford University. For 30 years (1970 through 2000) he worked at Oak Ridge National Laboratory, rising to the position of Corporate Fellow, a distinction shared by only 1% of the lab's technical staff. He has published almost 500 articles in the technical and semi-technical literature related to energy efficiency, utility resource planning, transmission adequacy and planning, generation adequacy, system operations, wholesale markets, and other issues related to the changes underway in the U.S. electricity industry.

JOHN B. HOWE is Vice President of Electric Industry Affairs for American Superconductor Corporation, a leading developer and manufacturer of superconductor technology for the electric power industry. Previously, he served as Chairman of the Massachusetts Department of Public Utilities (now the Department of Telecommunications and Energy), where he

spearheaded early stages of the effort to restructure and introduce retail competition to the state's regulated energy industries. Mr. Howe was also formerly a Vice President with U.S. Generating Company (now PG&E Generating Company). He has held leadership positions in the National Association of Regulatory Utility Commissioners, the New England Conference of Public Utility Commissioners, and several national and regional independent power industry organizations. He holds a B.A., Magna Cum Laude in Political Science from Amherst College and a Master of Arts in Law and Diplomacy, with a concentration in Energy and Resource Economics, from Tufts University's Fletcher School of Law and Diplomacy.

JAMES L. KIRTLEY is Professor of Electrical Engineering at MIT, where he has specialized in the development and analysis of electric machinery for 30 years. He is also Vice President and Chief Scientist at SatCon Technology Corporation, and has held positions with the Swiss Federal Institute of Technology, General Electric and Raytheon. A Fellow of the Institute for Electrical and Electronic Engineers, Dr. Kirtley is Editor in Chief of IEEE's Transactions on Energy Conversion and was the recipient of IEEE's Third Millennium Medal in 2000. He has published 45 professional journal articles, numerous conference papers, and been awarded 17 U.S. patents. Dr. Kirtley received his undergraduate, masters, and doctoral degrees in Electrical Engineering from MIT.

RALPH D. MASIELLO holds a doctorate in Electrical Engineering from the Massachusetts Institute of Technology where he worked on some of the first applications of modern control and estimation theory to electric power systems, as well as state estimators for Transmission Operations. Since then, Dr. Masiello has acquired over 20 years of experience in Transmission and Distribution Operations, having been involved in the implementation of control systems at many of North

America's largest utilities. In addition he has assisted in the design and set up of deregulated energy markets across the United States and around the world. He is currently Senior Vice President of Caminus Corporation, a leading provider of software solutions and strategic consulting to entities participating in competitive energy markets. He was formerly the global Business Unit manager for Energy Information Systems for ABB, as well as marketing manager for ABB Information Systems Division, and General Manager of ABB's Systems Control Division in Santa Clara. Dr. Masiello has been an adjunct professor at the University of Minnesota and lectured at University of California at Berkeley, the University of Arizona, and the University of Wisconsin. He is a Fellow of the IEEE and has held several committee, advisory and editorial positions within IEEE and authored numerous technical papers.

HYDE M. MERRILL is the founder of Merrill Energy LLC, which provides advanced risk, engineering, and economic analyses for participants in modern energy markets. He is currently leading a major study of power plant reliability and market behavior for a US ISO. He has advised the Peruvian Tariff Commission on transmission planning, standards, economic and institutional issues associated with competitive power markets, as well as being a member of an international consortium guiding the creation of a power pool in Southern China. Dr. Merrill organized a team that assessed market risks in four US regions, as well as advising on a Quebec commission charged with investigating the massive power losses in the Province. Dr. Merrill was the executive chairman of the Power Industry Computer Applications (PICA) Policy Committee for four years, and is currently a fellow of IEEE. He is the author of more than 70 technical publications on the power industry. Dr. Merrill holds an undergraduate degree in mathematics from the University of Utah and a Ph.D. in electrical engineering from MIT.

TIMOTHY DOUGLAS MOUNT is professor at Cornell University in the Department of Applied Economics and Management. His research areas include market power and price volatility in restructured markets for electricity, alternative auction institutions for electric power markets, as well as global environmental economics. Among other societies, he is a member of the International Association of Energy Economics, American Statistical Association, and Association of Environmental and Resource Economists. Professor Mount has published numerous articles on the power industry as well as environmental and agricultural economics. He received his doctorate in agricultural economics from the University of California at Berkeley.

SHMUEL S. OREN is Professor of Industrial Engineering and Operations Research at the University of California at Berkeley. With a doctoral degree from Stanford University in Engineering Economic Systems, Dr. Oren's research has focused on electric power system economics, and in particular on optimization and pricing strategies. In addition to his position at Berkeley, Dr. Oren has served as an expert consultant to numerous agencies, research institutes, and private entities including EPRI, SRI International, Niagara Mohawk Power Corporation, Entergy, and the Texas Public Utility Commission. He is a Senior Member of IEEE's Power Engineering Systems Society, as well as a member of the Institute for Operations Research and Management Science (INFORMS), the International Association of Energy Economists (IAEE), and the Mathematical Programming Society. Dr. Oren serves on the editorial boards of both INTERFACES and ENERGY ECONOMICS, and has published dozens of professional articles in his field, covering such topics as transmission congestion, flow-based transmission rights, generation unit commitment methods, and market pricing methodologies.

MICHAEL H. ROTHKOPF received his doctorate in operations research from MIT in 1964, and has been a professor of management and operations research at Rutgers University since 1988. He has served as the senior scientist as Lawrence Berkeley Laboratory, as well as leading their energy analysis program. His research and professional interests of long standing include models of markets and of competitive bidding, applications of operation research, and energy economics. Professor Rothkopf has edited a book on the power generation-unit commitment problem. In addition, he has written over 50 papers that have appeared in archival journals. Professor Rothkopf is a member of the Institute for Operations Research and Management Science, International Association of Energy Economists and American Economic Association. In addition, he was Editor-in-Chief of *Interfaces* from 1993 to 2000, and area editor for Operations Research Practice for the Journal Operations Research from 1984 to 1993. Professor Rothkopf is also a part-time consultant for FERC.

ROY J. SHANKER received his doctorate in industrial administration from Carnegie Mellon University in 1975. Dr. Shanker has been an independent consultant since 1981, providing management and economic consulting services in natural resource-related industries, particularly in the electric and natural gas utilities. In this capacity he currently serves on the Energy Markets Committee, the Transmission Expansion Advisory Committee and the Tariff Committee of the Pennsylvania Maryland and New Jersey (PJM) Office of Interconnection. Dr. Shanker also serves as a member of the New York Independent System Operator Technical Information Exchange Committee and participates on the NYISO Business Issues Committee, the Scheduling and Pricing Working Group, the Market Structure Working Group and several other working groups supporting the New York wholesale electric market.

THOMAS R. SCHNEIDER is a principal in the consulting firm of TRSenergy in Portola Valley, CA, specializing in technology evaluation and product positioning in restructured electricity markets, in addition to the development and implementation of technology acquisition strategy. From 1987 to 1997 Dr. Schneider was the executive scientist at the Electric Power Research Institute in Palo Alto, California, where he conceived and led institute efforts to sponsor fundamental and novel research in power systems engineering, as well as identifying the importance of power-industry restructuring on power system operations and reliability. In addition to numerous other appointments in the power industry, Dr. Schneider is currently the Chairman of the IEEE-USA Energy Policy Committee, where he served as Vice Chairman from 1998 to 2000, and a member of the IEEE Technology Policy Council. Dr. Schneider has contributed extensively to books on the power industry, proceedings and congressional testimony, and holds a Ph.D. in Physics from the University of Pennsylvania.

RICHARD TABORS is an engineering economist and scientist with over 30 years of domestic and international experience in energy systems planning and pricing. Dr. Tabors is President and founder of Tabors, Caramanis and Associates (TCA), an engineering and economics consulting firm specializing in policy development, business planning and technical analysis in the energy and utility sectors in the United States and internationally. He is also Senior Lecturer in Technology and Policy at Massachusetts Institute of Technology and has provided testimony and worked with clients throughout the country. His work with coauthors Fred C. Schweppe, Michael Caramanis and Roger Bohn published in SPOT PRICING OF ELECTRICITY is recognized as one of the theoretical foundations of electric industry pricing and restructuring. Dr. Tabors earned his undergraduate degree from Dartmouth College, and his doctorate from the Maxwell School at Syracuse University. He

is co-author of 5 books and over 100 professional articles and reports. He is a member of the IEEE and the International Association of Energy Economists.

ROBERT J. THOMAS is Professor of Electrical Engineering at Cornell University, where he specializes in power systems analysis and in particular the analysis and control of linear and nonlinear continuous and discrete time dynamical systems, complex networks, and applications of these to large-scale electric power systems. He is also currently the Director of the Power Systems Engineering Research Center (PSERC), a National Science Foundation Center and a Steering Committee Member for the Consortium for Electric Reliability Technology Solutions (CERTS). Dr. Thomas' affiliations and awards are far too numerous to list in full, but have included a variety of memberships and positions with the USDOE Secretary of Energy's Power Outage Study Team, the Institute for Research and Education for Electric Power, the Edison Electric Institute, and Drexel University's Department of Electrical and Computer Engineering Advisory Committee. He is a member of the Board of the IEEE and Chair of the IEEE Technology Policy Council. He has published approximately 60 professional articles and served as Editor for a number of prestigious technical journals. Dr. Thomas received his undergraduate, masters, and doctoral degrees in Electrical Engineering from Wayne State University.

LEE WILLIS is a registered professional electrical engineer with 30 years of experience in the electric power industry, specializing in transmission and distribution systems issues. Currently Vice President of Technology and Strategy at ABB Consulting, he has held executive positions with ABB Inc as Vice President of Distribution Systems, Director of Technology for Distribution Automation, and as an Institute Fellow at ABB's R&D Lab. He has also held positions in transmission and distribution at Westinghouse Electric and Houston Lighting and

Power. He is a Fellow of the IEEE, a member of the National Research Council, and the editor of the Power Engineering Series for Marcel Dekker Publishers of New York. He is the author or coauthor of 47 engineering journal articles, and five books including the POWER DISTRIBUTION PLANNING REFERENCE BOOK, SPACIAL ELECTRIC LOAD FORECASTING, and DISTRIBUTED POWER GENERATION–PLANNING AND EVALUATION. He earned his undergraduate and master's degrees in electrical engineering from Rice University.

BRUCE F. WOLLENBERG has been a professor in the Electrical Engineering Department at the University of Minnesota, Twin Cities, since 1989. Prior to his appointment, he worked at Control Data Corporation's Energy Management System Division, where he was responsible for the development of Artificial Systems Applications. He consulted on advanced research projects in energy management system application software, and he also participated in the power system operator training simulator project for the Electric Power Research Institute. Professor Wollenberg's current interests involve the development of large scale network solution algorithms using vector processing supercomputers, the extension of traditional power system control techniques to incorporate spot pricing algorithms and distributed computer technologies, as well as the application of expert systems to enhance the information presented to power system operators using real time computers.